REPORTS on the MARINE BIOLOGY of the SUDANESE RED SEA, from Collections made by CYRIL CROSSLAND, M.A., B.Sc., F.Z.S.: together with Collections made in the Red Sea by Dr. R. HARTMEYER.—XV. The BRYOZOA. By ARTHUR WM. WATERS, F.L.S.

PART II.

CYCLOSTOMATA, CTENOSTOMATA, AND ENDOPROCTA.

(PLATES 24 & 25.)

[Read 16th December, 1909.]

THESE collections of the Red Sea Cyclostomata, Ctenostomata, and Endoprocta, representing but few species, have been studied together with the other collections made by Mr. Crossland from Zanzibar and Cape Verde Islands, and when the description of these is reached I hope to be able to add some details.

When considering the Ctenostomata I indicate the direction in which it seems that we must work in order to make the classification more satisfactory, and show that the Stolonifera of Ehlers contains: firstly, some species having usually a thick stem to which the zoœcia are directly connected as in *Zoobotryon*; and, secondly, others with a creeping filamentous tube or rhizome, which expands in places, and from these swollen nodes the zoœcia grow, in most cases from a joint attached to the expansion. It is now proposed to limit the Stolonifera to these last, of which *Hypophorella* and *Farella* may be taken as typical; and then the first group remain as Vesicularina. In Vesicularina a gizzard seems to be universal, but is not found in the other group. Details concerning the gizzards are given in the paper. Unfortunately I do not possess satisfactory specimens of several of the Ctenostomata, and therefore only locate some of the genera tentatively, but hope shortly to obtain specimens of other genera from which to cut sections. It will be noticed that nearly all the Cyclostomata and Ctenostomata from the Red Sea are also known from the Mediterranean. In this and the previous paper 99 Red Sea species and varieties are referred to; of these, 34 are known from the Atlantic, 26 from British Seas, 39 from the Mediterranean, 34 from Indian and neighbouring seas, 18 from Crossland's Zanzibar collection, 8 from Japan, and 36 from Australia.

Since my previous paper was written *Membranipora limosa*, Waters, has been recognized by Levinsen from Formosa Channel.

Table of Distribution from West to East, as in Part I., pages 126–128, *of this volume.*

Page.		Cape Verde Is.	Atlantic.	British.	Mediterranean.	RED SEA.	Indian Ocean.	Ceylon.	Zanzibar.	Japan.	Australasian.	Fossil.
	CYCLOSTOMATA.											
232	*Crisia denticulata,* Lamk. ..	+	+	+	+	+	..	..	..	..	+	
234	,, *producta,* Smitt	..	..	+	+	+						
234	,, *ramosa,* Harmer	..	..	+	+	+						
235	,, *cylindrica,* Busk	..	..	..	..	+						
235	*Filisparsa tubulosa,* Busk ..	..	+	..	+	+	..	..	..	..	+	+
237	*Lichenopora radiata,* Aud. ..	..	+	+	+	+	..	..	..	+	..	+
	CTENOSTOMATA.											
243	*Amathia tortuosa,* T.-Woods .	..	..	..	..	+	..	..	..	..	+	
243	*Zoobotryon pellucidum,* Ehr...	+	+	..	+	+	..	..	+	..	+	
248	*Bowerbankia imbricata,* Adams	..	..	+	+	+						
250	*Valkeria uva,* L.	..	..	+	+	+	..	+	+			
251	*Cylindrœcium dilatatum,* H. .	..	..	+	+	+	+	+				
251	,, *giganteum,* B. .	..	..	+	+	..	..	+				
	ENDOPROCTA.											
251	*Barentsia gracilis,* Sars	..	+	+	+	+	..	..	..	..	+	
252	*Loxosoma Kefersteinii,* Clap. .	..	..	..	+	+						
	ADDENDA.											
253	*Aetea Crosslandi,* sp. nov. ..	..	..	..	..	+						
254	*Retopora abyssinica,* var. *expansa,* nov.	..	..	..	..	+						

CYCLOSTOMATA.

CRISIA DENTICULATA (*Lamarck*). (Plate **24**. figs. 1–3 ; Plate **25**. fig. 11.)

Cellaria denticulata, Lamk. Anim. sans Vert. vol. ii. p. 137.

Crisia denticulata, M.-Ed. Ann. Sc. Nat. ser. 2, vol. ix. p. 201 (9), pl. 7. fig. 1; Harmer, "Brit. Spec. of *Crisia,*" Micr. Journ. vol. xxxii. n. s. p. 129, pl. 12. figs. 1–3 (1891). For other synonyms, consult Miss Jelly's Catalogue.

As Harmer has shown, we cannot in a large number of cases be sure as to authors' determination of *C. denticulata*, and Busk had more than one species before him when preparing his catalogue. There is, however, no doubt that it occurs in the British and neighbouring seas, the Mediterranean and the Red Sea, and Australia, and though certainly elsewhere also, we must wait until more comparative studies of the ovicell have been made before we can be certain as to the distribution. There is below the aperture a small thin oval spot (fig. 11), clear in balsam preparations, which occurs in all specimens examined from various localities, but does not seem to have been mentioned, though a mark somewhat lateral is shown by Hincks. I do not find this mark in any other species nor in *Crisia denticulata*, var. *gracilis*, Busk, which, however, I should not place with *denticulata.*

The ovicell is lateral, short, and pomiform, as I would call such ovicells, in opposition to the pyriform ovicells. In two or three cases there is a narrow tube from the distal base of the ovicell.

The distance from zoœcium to zoœcium is about 0·28 mm. Without the ovicells the determination of *Crisia* is most difficult and often with small pieces impossible.

However, another character of great importance is the distance apart of the zoœcia, and if mature portions are taken and not the extremities it will be found that most correspond very nearly to type measurements. For such measurements I set the threads of a micrometer over a typical portion and then bring a number of others under the micrometer. Harmer has shown that the position of the *basis rami* may be of use in some species, but the number of cases in which it will be of use is somewhat restricted. The position depends to a large extent upon the width of the opening for the joint, and it is worth attention that the size of the main and lateral joints seems in all cases to be the same, and when they are very large then the opening is directed laterally and is usually about halfway between the two zoœcia. The size of the aperture of the zoœcia is certainly a character of primary importance and there is but very slight variation through a colony. The mode of branching is often a character of considerable value. The position of the joint has been stated in two ways, either counting all the zoœcia of an internode below the new branch, or only the zoœcia on the one side, as, for example, the fifth zoœcium of an internode is the third on the side from which the new branch commences. Harmer in his important paper on *Crisia* speaks of the number on the one side, and I shall therefore follow him, though perhaps it would have been better to give the total number of zoœcia before the commencement of a branch.

In the *C. tubulosa* group the zoœcia are far apart (about 0·5–0·6 mm.), the aperture of the zoœcia is large (about 0·1 mm.), the ovicell is central, pyriform, and long. In *C. ramosa*, Harm., the distance is about 0·4 mm. apart, with the aperture about 0·07 mm. In the *C. denticulata* group the distance is about 0·3 mm., the aperture about 0·06 mm., the ovicells are shorter and more to one side than in the truly pyriform ovicells.

We are acquainted with radicles in various positions, but one from Khor

Dongola having them from each terminal zoœcium has been thought worthy of a figure (Pl. **24**. fig. 3).

In the Sudan specimens I have seen a few short tubules to the closures and have not seen them in any other *Crisia*.

Loc. British, French, and neighbouring seas, Cape Verde Is. (*Cross. Coll.*), Mediterranean, Cape York, Australia (*Chall.*), Khor Dongola (19*) ; Engineer Island, Khor Dongola, collected by Crossland ; Ras el Millan, collected by Hartmeyer.

CRISIA PRODUCTA, *Smitt.*

Crisia producta, Smitt, Öfv. K. Vet. Förhandl. p. 116, pl. 16. figs. 4–6 (1865).

See Miss Jelly's Catalogue under *C. eburnea*, var. *producta*, and add :—*Crisea eburnea*, var. *producta*, Levinsen, "Mosdyr," Zool. Danica, vol. iv. (1894) p. 74, pl. 6. fig. 40.

There are a few small specimens which fairly agree in size of the zoœcial aperture (0·06 mm.) with *C. cornuta* and *C. geniculata*, and I certainly see no reason for placing it near *C. eburnea*, in which the growth of the new zoœcium forming a fresh branch is very different. The growth of the Mediterranean *C. fistulosa*, Heller, is similar, but the zoœcia in that species are much stouter, with wider apertures (0·1–0·11 mm.), the joints are larger and the internodes are longer, so that they are easily distinguishable. However, we may imagine, from *C. geniculata*, placed under favourable circumstances, the form *producta* arising and then growing into the stouter *C. fistulosa*. *C. geniculata* occurs near Naples.

Loc. Arctic, British, Danish, Naples, Suez, Sudan (18*), collected by Crossland.

CRISIA RAMOSA, *Harmer.*

Crisia ramosa, Harmer, "Brit. Spec. of *Crisia*," Micr. Journ. vol. xxxii. n. s. p. 134, pl. 12. figs. 10, 11.

There are from the Sudan a few small pieces, which appear much more delicate than most parts of *C. ramosa*, the zoarium being only about 0·1 mm. wide, but on comparing with one of the lower branches of a good specimen of *ramosa* I found the similarity very close. Although the ovicell of the Sudan specimen is a trifle the smaller the shape is the same, and although the oœciostome is somewhat broken there evidently was a funnel. The distance from aperture to aperture is about 0·4 mm. and the zoœcial aperture is about 0·06 mm. The branches arise, as in the British specimens, usually after the first zoœcium on the one side. In specimens from Naples corresponding in the size of the zoœcia and the distance apart, the zoœcia usually arise after the second zoœcia, though I have seen some after the first ; the ovicells and the funnel are quite similar to the British form, as is also the frequency of

* These and similar numbers are Crossland's registration numbers.

branching, but the zoœcia in the branches are usually more numerous. The basis rami are placed high up as in the British form. This Mediterranean form is what I called *Crisia elongata* var. *angustata* *, though it does not seem that the specimen described and figured was a very characteristic one. It seems as though a modification of the position of the branches had taken place in the Mediterranean, but whether varietal or specific separation is justified can only be decided by the examination of considerable quantities from various localities. In my description of *C. elongata* var. *angustata* by a printer's error the distance from zoœcium to zoœcium is given as 0·04 instead of 0·4 mm.

Loc. Plymouth (*Harm.*), Naples (*A. W. W. coll.*, the form referred to). From among the Lamellibranchs which cover the rock at Suez (18), collected by Crossland.

CRISIA CYLINDRICA, *Busk*. (Plate **25**. figs. 14, 15.)

Crisia cylindrica, Busk, Zool. 'Chall.' Exp. vol. xvii. (1886) pt. L. p. 7, pl. 2. figs. 2–4.

On *Canda arachnoides*, Lamx., from Gimsah Bay there is a small colony, which seems to be *C. cylindrica*. At the base there is a blind internode and the zoarium is at first very narrow ; after the second zoœcium branching takes place followed by a branch on the other side after the fourth zoœcium.

The zoœcia are about 0·28 mm. distant and the zoœcial aperture is about 0·05 mm. The ovicell is shortly pyriform with a tubular oœciostome with the opening about 0·05 mm. wide. The pores on the zoœcia are very large. Busk does not figure the ovicells, though he refers to them ; but in the British Museum collection of the 'Challenger' specimens I have not found any, however in these the zoœcia are about 0·35 mm. apart. In the 'Challenger' mount a new branch arises from the end of the zoœcial tube, as figured in the 'Challenger' Report, pl. ii. fig. 2 *a*, but as it is not alluded to by Busk it seems advisable to call attention to the unusual growth, which might possibly be passed over as an artist's mistake.

Loc. Nightingale Island, 100–150 fath. ('Chall.') ; Gimsah Bay, collected by Hartmeyer.

FILISPARSA TUBULOSA, *Busk*. (Plate **25**. figs. 16, 17.)

Hornera violacea, var. *β. tubulosa*, Busk, Cat. of Mar. Polyzoa, p. 19, pl. 18. fig. 4 (1875).

Filisparsa sp., Manzoni, "Bry. du Plioc. de Rhodes," Mém. Soc. Géol. de France, 3e sér. vol. i. (1877) pt. ii. p. 69, pl. 3. fig. 18, *a* & *b*.

Filisparsa tubulosa, Waters, Ann. Mag. Nat. Hist. ser. 5, vol. iii. (1879) p. 275; id. vol. xx. (1887) p. 257.

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* "Bry. of the Bay of Naples," Ann. Mag. Nat. Hist. ser. 5, vol. iii. (1879) p. 269, pl. 23. fig. 4.

Filisparsa Delvauxi, Pergens, "Plioc. Bry. de Rhodes," Ann. Nat. Hist. Hofmus. Wien, vol. ii. (1887) p. 6; Bull. Soc. Belge de Géol. vol. iii. (1889) p. 64; Bull. Soc. Roy. Malac. de Belge, p. (2) & p. (6) (1889).
? *Idmonea gasparensis*, MacG. Trans. Roy. Soc. Vict. vol. xxiii. p. 185, pl. 2. fig. 3.

The specimen from Ras el Millan is only small and is partly covered by an encrusting foraminifer, but it shows the formation of the ovicell on the anterior surface very well. The end of the branch is clavate, and here the wall to cover the cell has just commenced to form, so that zoœcia passing through the ovicell become funnel-shaped at the end—that is to say, from each zoœcium the finely perforated ovicell wall is commencing to grow, and will join the wall growing up from the base. It will be seen from the figure that there are a large number of zoœcia in the ovicell. On the dorsal surface, near the ovicell, two or three zoœcia are seen, at first suggesting *Entalophora.*

The apertures of the zoœcia are about 0·13 mm.

Filisparsa, as illustrated by d'Orbigny, may include forms belonging to more than one genus; but *F. neocomiensis*, d'Orb., may be taken as the type, with *F. crassa* doubtful. I* have previously alluded to the fact that the ovicell of *Filisparsa* is anterior, whereas in *Idmonea irregularis*, Meneghini, the ovicell is dorsal. Perhaps the genus *Tervia* may be retained for that group, as *Tervia folina*, Jull., is the *Idmonea irregularis,* Meneg. However, we stand on very uncertain ground regarding these genera until the ovicells of more species are definitely known. The dorsal position of the ovicell, which in this respect resembles *Hornera*, seems sufficient to remove such species from *Idmonea*, but of this we are not quite certain. From Zanzibar I have specimens in most respects like *Idmonea irregularis*, with the ovicell anterior spreading for a considerable length among the zoœcia, with the oœciostome curved over like the indraught funnel of a steamer. In considering the value of the position of the ovicell, we must not forget the extraordinary ovicells of *Idmonea Meneghini*, Heller †, in which they take the place of one complete lateral series, showing what different forms the ovicells may take.

Loc. Naples (*W.*); North Atlantic (*B.*); Holborn Island, Queensland, 20 fath. (*W.*); Victoria ?; Ras el Millan, collected by Hartmeyer.

Fossil. Rhodes; Wola Lu'zanska (Eoc.). Mamàh (Tert.).

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* Quart. Journ. Geol. Soc. vol. xl. (1884) p. 687.

† Waters, "Ovicells of Cyclostomatous Bryozoa," Journ. Linn. Soc., Zool. vol. xx. (1888) p. 278, pl. 14. fig. 2.

LICHENOPORA RADIATA (*Audouin*).

For synonyms, see Miss Jelly's Catalogue, and add:—

? *Diastopora catillus*, Johnson, "Cyclos. Bry. found at Madeira," Ann. Mag. Nat. Hist. ser. 6, vol. xx. (1897) p. 61.

Lichenopora radiata, Neviani, "Bri. neog. delle Calabrie," Pal. Ital. vol. vi. (1900) p. 246; Bri. foss. della Farnesina & Monte Mario, presso Roma," Pal. It. vol. i. (1895) p. 135; Calvet, "Bry. mar des Côtes de Corse," Trav. de l'Inst. de Zool. de Montpellier, sér. 2, Mém. 12, p. 44 (1902); Ortmann, A., "Die Japan. Bry.," Arch. für Naturgesch. vol. i. (1890) p. 64; Jullien & Calvet, 'Bry. provenant des Campagnes de l'Hirondelle,' p. 119 (1903); Norman, "Polyzoa of Madeira," Journ. Linn. Soc., Zool. vol. xxx. (1909) p. 281.

There are a few specimens from among the lamellibranchs which cover the dock walls at Suez. *L. radiata* has 9 tentacles. I can only give *Diastopora catillus* as a synonym on Norman's authority, as the description does not at all correspond.

Loc. British; Mediterranean; Bay of Biscay, 135 met. (*J. & C.*); Madeira (*Norm.*); Japan (*Ort.*); Samoa, mentioned by Ortmann; Suez (18), collected by Crossland.

Fossil. Farnesina (Postpliocene); Pliocene and Postpliocene of Calabria and Sicily.

CTENOSTOMATA.

The examination of the Ctenostomata from Mr. Crossland's collections has left me dissatisfied with our knowledge of this group; although the characters used are mostly zoarial, the way in which the zoarium grows and spreads, which is undoubtedly a character of considerable importance, has in most cases been insufficiently described.

The group is based upon the so-called setose collar; but this is an unsatisfactory name, for though there may often be an appearance of spines or hairs projecting from the aperture, further examination with sufficient magnification shows that this is not the case, and that there is only a cylindrical prolongation which is thrown into folds with thicker ridges. This collar has been correctly described by Ehrenberg, Ehlers, and others; and Jullien has shown that to speak of it as setose has been misleading. However, it has even been described as having bristles round the aperture. This collar may be seen projecting from the aperture of a zoœcium in which all the organs have disappeared, and this makes it difficult to follow Ehlers in considering that it represents the diaphragm or sphincter which closes the tentacular sheath of the Cheilostomata.

(1) First, there is a group forming a fleshy or chitinous expansion, either adnate or erect, in which the zoœcia are developed directly from other

zoœcia. There is no gizzard, there are a considerable number of tentacles; some are oviparous and produce Cyphonautes.

The genera included are *Alcyonidium*, *Flustrella*, *Pherusa*, *Clavopora*, and *Lobiancopora*. This group has been recognised as Alcyonellea, but has also received other names. The remainder have been grouped together as Stolonifera, Ehlers, but it seems to me that two quite distinct things have been called stolons. The genus *Hypophorella* of Ehlers, which is really the type of the Stolonifera, has a creeping or erect tubular filamentous stolon or rhizome—that is, a very slender and delicate tube expanding at intervals for the production of zoœcia, as in *Hypophorella*, *Farella*, *Triticella*, *Valkeria*, *Mimosella*; so that the term rhizome used by Foettinger and Potts in describing *Pedicellina* seems very appropriate, as the growth is usually similar to the rhizome of plants.

(2) Next we have a group with a free thick stem from which the zoœcia grow direct from various parts, as in *Zoobotryon*, *Amathia*, &c., and none seem to grow from a thin segmented creeping filament, though in *Amathia* * the stem at first spreads out on the supporting surface; and then in places on the stem a watch-glass hollow is formed from which the subcolonies arise. In all the genera with these uniform thick free stems there is a gizzard, and the number of tentacles is usually small (8–10). The genera included are *Zoobotryon*, with its synonym or ally *Bowerbankia*; *Amathia*; *Vesicularia*; and *Buskia socialis* †, Hincks; *Avenella* (?), Dalzell; *Cryptopolyzoon*, Dendy. It will be best to restrict the name Vesicularina to this group, although both Ehlers and Hincks put the various species under the Stolonifera.

(3) Lastly, the Stolonifera as now limited have, as a rule, no gizzard, but Joyeux-Laffuie mentions one as a generic character in *Hypophorella*, though without further particulars; however, as nothing of the kind is mentioned or figured by Ehlers, I take it that there is no gizzard in *Hypophorella*, though until sections have been made there will be some uncertainty. Some text-books have, however, incorrectly given the gizzard as a character of the whole Ctenostomata. Hincks mentions a gizzard in *Avenella*, in which the number of tentacles is given as 20–24. It is clear that search should always be made for the gizzard, although we do not at present know what the classificatory value may be.

As stated, in *Hypophorella*, *Farella*, *Valkeria*, *Triticella*, there is a delicate rhizome which expands at intervals, and from this expansion one or a pair of zoœcia grow, and also one or two fresh creeping filaments or radicles at right angles to the parent tube; or from the expansion a nodular attached growth may take place on each side, and from each nodule a fresh pair may grow forming groups of zoœcia as in *Valkeria*. Throughout the group there is a tendency to grow in pairs (Pl. 24. fig. 14, &c.). The creeping stolon has a septum immediately following the expansion just mentioned; and in *Farella repens*, Farre, and *Valkeria uva*, L., there are muscles across the expansion as figured by Ehlers in *Hypophorella expansa**, Ehl., but these points have been overlooked in both species †.

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* A short radicle attachment is thrown out here and there for attachment.

† See p. 241.

We may hope that the zoœcia will give us some useful characters, but so far but few have been found. I would, however, point out two that should be looked for. The zoœcium (after the tentacles, other organs, and muscles have disappeared) often has quite a different form from the ordinary zoœcia; then, as Farre ‡ has mentioned, the position of the parietal muscles should be examined. These muscles may be single, or in groups of two, four, or even more, and probably the different shape of the empty zoœcial chambers is caused by the disappearance of these muscles. The empty zoœcial chambers are well figured by Ellis (Nat. Hist. Corallines, pl. xv. fig. C). I also think that the appearance called in some species by the unfortunate name "area" depends upon contractions formed by these muscles—at any rate, in spirit specimens I have been unable to find any difference in the structure of the different parts of the zoœcial wall in any genus examined.

In making the group Stolonifera, Ehlers showed how various Bryozoa grow from creeping stolons, and that they occur in *Crisia*, *Chlidonia*, *Pedicellina*, &c. Since Ehlers wrote there have been many changes of opinion, and it would hardly serve any purpose to criticize all the conclusions he came to at that time, though we may say distinctly that a somewhat similar growth, from filaments, may take place in most widely separated genera. In *Crisia* creeping stolons are formed, and from these at intervals subcolonies arise, and, further, sometimes from the ordinary radicles a fresh zoœcial growth may start; but from what I have seen this growth takes the same form as an older internode, whereas the first and subsequent subcolonies growing from the stolon in *Stirparia*, *Gemellaria*, and various other Cheilostomata consist at the base of one zoœcium from which the others grow, though maintaining a slender growth for some distance before the branches attain their ordinary size, for in these cases the first zoœcium of each subcolony has the form of a primary zoœcium. There is also a rhizome in *Alysidium Lafontii*, Aud., and *Micropora ratoniensis*, Waters, and in this last subcolonies grow from the rhizome. In *Aetea*, *Beania mirabilis*, Johnst., and *Hippothoa* the creeping portion is connected directly with the rest of the zoœcium, forming one chamber, and this cannot be compared with the rhizome of the Stolonifera.

Busk made a group Stolonata for forms growing on a stalk, most of which give off numerous radicles, but a consideration of his list, in the 'Challenger' Report, suggests that they are not closely allied.

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* Abhand. d. Gesellsch. d. Wissenschaft Göttingen, vol. xxi. (1876) pl. i. figs. 3, 6.

† In the pinnæ of *Mimosella gracilis*, Hincks, there are similar muscles below the septum. There is usually a septum below each pair of zoœcia, but sometimes this is absent, and then there are no muscles.

‡ Phil. Trans. (1837) p. 396, Pt. I. pl. 21. fig. 13, pl. 24. fig. 3, no. 3, figs. 4, 5.

The larva of but few genera is known, but Prouho shows that *Hypophorella* lays an egg, and has a larva with the characters of Cyphonautes, though whether it has a "shell" is not conclusively shown. Several of the Ctenostomata discharge an unsegmented egg, either through an intertentacular organ (*Alcyonidium duplex*, Prouho ; *A. albidum*, Ald.) or through a simple opening by the base of the tentacles (as in *Hypophorella*, Ehlers ; *Farella repens*, Farre), but in the majority the larva develops in the tentacular sheath. This naturally requires much space, and the polypide usually dies down as the larva develops. In the Cheilostomata, when there is an ordinary ovicell, whether external or internal (as in *Lepralia cucullata*, &c.), there is no necessity for the disappearance of the polypide, and we find long rows of polypides in perfect activity, with ova developing and larvæ in the ovicells. Exact observations on the development have been made on but few Ctenostomata. It is very likely that a comparative study of the primary zoœcia of the Ctenostomata may give us valuable assistance.

Pending further examination the Ctenostomata may be provisionally tabulated as

ALCYONELLEA.

Usually many tentacles ; no gizzard ; larva in some species with intestine, and sometimes Cyphonautes.

Alcyonidium, Lamx. 15–27 tentacles ; no gizzard.

Flustrella, Gray. 19–27 tentacles (*Waters*), 30–35 (*Hincks*) ; no gizzard.

Pherusa, Lamx. 15 tentacles (*Waters*) ; no gizzard.

Lobiancopora, Pergens [*]. 24 tentacles ; no gizzard. Probably belongs here.

? *Clavopora*, Busk, 1874. Apparently belongs to this division. It has been subsequently described as *Aschoriza*, Fewkes (16–18 tentacles) (*Robertson*).

VESICULARINA.

Usually 8–10 tentacles ; a gizzard ; the zoœcia grow direct from the stem and have no independent movement.

Zoobotryon, Ehr. 8 tentacles ; a gizzard.

Bowerbankia, Farre. 8–10 tentacles ; a gizzard. Apparently a synonym of *Zoobotryon*.

Amathia, Lamx. 8–10 tentacles ; a gizzard.

Vesicularia, Thomps. 8 tentacles ; a gizzard.

? *Avenella*, Dalzell. 20–24 tentacles ; a gizzard (*Hincks*).

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[*] Sections show that *Lobiancopora hyalina*, Pergens, has an intertentacular organ.

Buskia socialis, Hincks. 8 tentacles; a gizzard (*Waters*), This must be put in another genus, as it differs widely from *B. nitens*, Alder, and *B. setigera*, H. The zooecia are attached direct to the thick stem, whereas in *B. setigera* there is a rhizome.

Cryptopolyzoon, Dendy. 10–14 tentacles; a gizzard with two grindstone teeth, entirely different to the gizzards of other genera.

Stolonifera.

There is a delicate creeping rhizome, which at intervals expands, and from these expansions the zooecia arise usually in pairs; no gizzard.

Hypophorella, Ehlers. 10–11 tentacles. Joyeux-Laffuie mentions as a character a gizzard, but does not refer further to it, and from Ehlers's fuller description it certainly does not seem that there is a gizzard.

Farella, Ehrenberg. 11–12 tentacles; no gizzard.

Valkeria, Flem. 8 tentacles; no gizzard.

Mimosella, Hincks. 8 tentacles; no gizzard.

Triticella, Dalzell *. 18–20 tentacles; no gizzard (*Hincks*).

Cylindrœcium, Hincks. 10–20 tentacles; no gizzard.

Buskia setigera, Hincks. No gizzard.

The following cannot at present be placed:—*Anguinella*, V. Ben.; 10 tentacles, no gizzard (*H.*). *Arachnidium*, Hincks., is not this allied to *Cylindrœcium*? *Victorella*, Saville Kent, 12–14 tentacles. S. Kent said no gizzard, but Bousfield and Kraepelin state that they found one, though as the description hardly corresponds with the gizzard of other species sections are desirable. Loppens † has recently stated that there is no gizzard. Perhaps this should be put in a separate group with *Paludicella*. *Arachnoidea*, Moore, looks like *Arachnidium*. *Monastesia*, Jullien, is perhaps *Buskia*. *Hislopia*, Carter, is said by Carter ‡, Jullien §, and Annandale || to have 16 (?) tentacles, and a gizzard, which from the description is somewhat like that of *Cryptopolyzoon*, but further details are required. It is an encrusting species. *Norodonia*, Jullien: Annandale considers that this is *Hislopia*.

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* *Hippuraria*, Busk, has a delicate rhizome, from which groups of zooecia arise. In the only specimen (which is now in the British Museum) it is growing upon the stalk of a seaweed, and this was mistaken for the stem of *Hippuraria*. There is, therefore, now absolutely no reason for separating *Hippuraria* from *Triticella*.

† Loppens, K., "Bry. d'eau douce," Ann. de Biol. lacustre, vol. iii. (1908) p. 9.

‡ Ann. Mag. Nat. Hist. ser. 3, vol. i. p. 169, pl. 7 (1858).

§ "Monog. des Bry. d'eau douce," Bull. Soc. Zool. de France, vol. x. (1885) p. 95, figs. 248–250.

|| Annandale, "Affinities of *Hislopia*," Journ. Proc. As. Soc. Beng. n. s. vol. ii. n. 3, pp. 59–63.

AMATHIA.

All the specific characters used so far depend upon the position of the zoœcia or the size of some part of the colony.

The zoœcia are attached directly to the stem without any intermediary growth, and at the base of each zoœcium there is a rosette plate; the zoœcia have a gizzard and 8–10 tentacles; there is no rhizome; and the zoœcia are connate nearly the whole length, whereas in *Zoobotryon* and other genera of the Vesicularina they are free or partly so. The zoœcia are biserial, the series in some species forming a straight row along one side of the stem, in others forming more or less of a spiral, and the series may continue the whole length of the stem or may only cover a small portion near the bifurcation. The branches usually dichotomize, or there may be a main stem from which branches arise as in *A. plumosa*, MacG., while in *A. Wilsoni*, Kirkp., there are three branches at a node.

In some cases the terminal branches extend beyond the group of zoœcia, gradually diminishing in size, being divided by one or more dissepiments, the position of which furnishes useful classificatory characters. The spiral is usually definitely in one direction right or left in a species; but this is not universally the case—for example, in *A. convoluta*, Lamx., there may be a right curve in the older, and a left in the younger parts of the same colony.

In the present investigation I found that in *A. semiconvoluta* there is a light oval mark at the proximal end of each node (Pl. **24**. fig. 6), and a radicle to a few of the stems explained the meaning.

A similar light mark occurs in *A. brasiliensis*, Busk, and Busk mentioned the rooting of his *A. tortuosa=convoluta*; also radicles occur in *A. obliqua*. The partial or complete formation of a radicle chamber to each zoœcium or at regular intervals, even although few radicles may be formed, occurs in many species of Bryozoa.

In the northern hemisphere the only form with a straight row of zoœcia is the cosmopolitan *A. lendigera*, L., whereas in Australia this group is well represented by nine species; on the other hand, the group with the spiral series of zoœcia is well represented in the northern hemisphere. So far as I am aware, no *Amathia* has yet been found in the Arctic or Antarctic. Although we must not arrange classification according to geographical distribution, yet it may often be examined to give a check to the correctness of classification*.

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* The following table shows the distribution of the species, so far as can be judged from the descriptions. Species occurring in more than one region are printed in small capitals:—

Atlantic:—A. DISTANS, Busk; A. VIDOVICI, Hell. [the 'Challenger' specimens named *A. lendigera* are *A. Vidovici*, Hell., and in several other cases Busk does not seem to have recognised the difference]; A. LENDIGERA, L.

British and neighbouring seas:—A. LENDIGERA, L.

AMATHIA TORTUOSA, *Tenison-Woods* (non *Busk*). (Plate **24**. fig. 5.)

Amathia tortuosa, Tenison-Woods, Proc. Roy. Soc. Vict. vol. xvi. (1880) p. 89, fig. 6; MacGillivray, Prod. Zool. Vict. dec. xix. (1889) p. 308, pl. 185. fig. 3; Proc. Roy. Soc. Vict. vol. vii. (1894) p. 134, pl. A. fig. 4.

Amathia connexa, Busk, Polyzoa, Zool. Chall. Exp. vol. xvii. (1886) pt. 1, p. 35, pl. 6. fig. 3.

The specimens from the Sudan are about the same size as that figured by Tenison-Woods, but are a trifle smaller than the 'Challenger' *A. connexa*, B. The stem is about 0·2 mm. diam., and the wall is thin and transparent. The zoœcia are arranged spirally round the upper two-thirds of an internode.

A. distans, B. (Pl. **24**. fig. 7), *A. tortuosa*, T.-Woods (fig. 5), *A. brasiliensis*, Busk, and *A. semiconvoluta*, Lamx. (fig. 6), all form an incomplete spiral round the stem and only occupy part (more than half) of the internode, and from the descriptions determination is most difficult. However, the stem of *A. distans* is thin (0·12 mm. diam.) and chitinous; *A. tortuosa* has a colourless transparent stem much thicker (0·2 mm. diam.), whereas *A. semiconvoluta* has a dark chitinous stem (0·25 mm.), being altogether a larger species. *A. convoluta*, *A. semiconvoluta*, *A. spiralis* all have long zoœcia.

Loc. Port Jackson (*T. W.*); New South Wales (*MacG.*); off Cape York (*B.*); from s.s. 'Thyra' docked in Suez from Mediterranean (9), collected by Crossland.

ZOOBOTRYON PELLUCIDUM, *Ehrenberg*. (Plate **4**. fig. 12, 15.)

Zoobotryon pellucidus, Ehrenberg, Symbolæ Physicæ, pt. ii. Evertebrata (there is no paging), pl. iii. fig. 10 (1831); Reichert, "Vergleichende anatomische Untersuchungen über *Zoobotryon pellucidus*," König. Akad. Wissensch. Berlin, 1870; Phillips, Willey's Zool. Results, pt. iv., Cambridge, p. 450 (1899).

Hydra verticillata, Delle Chiaje, 'Memorie sulla storia e notamia degli animale senza vertebre del Regno di Napoli,' vol. iii. (1828) p. 203, pl. 47. figs. 1, 2.

Zoobothryon (sic) *verticillatum*, Delle Chiaje, "Desc. e Notam. degli anim. invert. della Sicilia citiore osservati vivi negli anni 1822-30," vol. v. p. 142, vol. vi. (1841) pl. 79. figs. 1, 2.

Hyalosiphon verticillatus, v. Martens, Ital. p. 453 (1844).

Serialaria Couthinii, F. Müller, Troschel's Arch. für Naturgesch. vol. i. (1860) p. 311, pl. 13. figs. 1-7.

Mediterranean:—A. LENDIGERA, L.; A. SEMICONVOLUTA, Lamx.; A. VIDOVICI, Hell.

Red Sea:—A. TORTUOSA, Woods.

Indian Ocean and Zanzibar:—A. DISTANS, B.; A. SEMICONVOLUTA, Lamx.; A. VIDOVICI, Hell.

Australian:—*A. cornuta*, Lamx.; *A. Brongniartii*, Kirkp.; A. BISERIATA, Krauss; A. DISTANS, B.; *A. spiralis*, Lamx.; *A. obliqua*, MacG.; *A. pinnata*, Kirkp.; A. TORTUOSA, Ten.-Woods; *A. plumosa*, MacG.; *A. bicornis*, T.-Woods; *A. convoluta*, Lamx.; *A. Woodsii*, Goldstein; A. LENDIGERA, L.

S. Africa:—A. BISERIATA, Krauss.

Dedalæa mauritiana, Quoy & Gaimard, Voyage de l'Uranie, vol. iv. p. 229, pl. 26. figs. 1, 2; Voyage de l'Astrolabe, p. 952, pl. xxvi. figs. 1–7.

Bowerbankia biserialis, Hincks, "Polyzoa of the Adriatic," Ann. Mag. Nat. Hist. ser 5, vol. xix. (1887) p. 309, pl. 9. fig. 6.

Vesicularia bilateralis, MacG. Trans. Roy. Soc. South Australia, p. 30, pl. 2. fig. 4 (1889).

Description of a Ctenostomatous Polyzoa, J. D. Macdonald, Proc. Roy. Soc. vol. viii. (1857) p. 383.

This has also been described in botanical works under various names as *Ulva intricata*, Clemente; *Valonia intricata*, Agh.; *Ascothamnion intricata*, Kütz.; *A. Trinitatis*, Sond.

Further particulars are given by Reichert and by Miss Jelly in her Catalogue.

This may be said to be Ehrenberg's type of Bryozoa, and was correctly and fully described by him. He saw the setose collar, as it has been called, also the gizzard, and gave the number of tentacles as eight.

Round this species there have been discussions not only as to whether it was a plant or an animal, but also as to whether the mesenchym threads were a colonial nervous system or a colonial organ of movement. When Hincks met with this classical genus he did not recognise it, and called it *Bowerbankia biserialis*, Hincks; however, thereby he unconsciously showed the identity of *Bowerbankia* with *Zoobotryon*, so that by the laws of nomenclature we are forced to drop the well-known genus and replace it by *Zoobotryon*, which will not be reverting to a disused name, but merely showing the identity of what have been understood as two genera. It is true that Hincks only speaks of two opposite branches at a joint, and in younger branches of *Z. pellucidum* this is often the case; besides Hincks's fig. 6 *a*, pl. 9, so far as I can understand it, shows two thick branches and a short terminal one, so that although the description does not correspond in this one particular, I think we may feel satisfied that *biserialis* is a synonym.

Ehrenberg first spoke of the "collare setosum," and Busk subsequently made the setose collar a distinctive character of his suborder Ctenostomata. In *Zoobotryon* there is no real setose collar, but the thin membrane is ridged and folded, and the lines of the fold give the appearance of separate setæ, but with higher powers it is clear that the membrane is continuous. The structure is correctly shown by Reichert, pl. 1. fig. 3, and by Ehlers for *Hypophorella expansa*, pl. 2. fig. 10, and some other term would have been more satisfactory, but neither "fringe" (*Hincks*) nor "bristles" is any better. In consequence of seeing that this collar is not divided in *Zoobotryon pellucidum* a large number of Ctenostomata have been examined without ever finding true setæ on the collar. At the time this examination was made it had escaped me that Jullien * had shown how this collar simulates by its folds a bundle of setæ. Busk, in his 'Challenger' Report, p. 37, says that

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* Mission du Cap Horn, p. 15.

Farella repens and *Farella elongata* have no setæ, but I find the collar is well developed in these species.

The gizzard of this group of the Ctenostomata was not quite correctly described by the earlier authors, and the only exact figures of the structure with which I am acquainted are those of Calvet [*]. In cross-sections there are from 30–50 teeth, varying much in the formidable terminations, which stain much darker than the rest. The ends in *Zoobotryon pellucidum* may be spear-headed, hammer-headed, two-pronged, or reflex uncinate.

There are two sets of larger teeth opposite one another, and it is these that are most noticeable, when the animal is alive or in whole mounts. Sections (Pl. **24**. fig. 15) show that the muscular wall of the gizzard has sometimes separated from the teeth, and then the contents of the teeth are attached to the muscular wall and are more or less drawn out of the teeth. I have found identically the same separation of the contents in *Bowerbankia imbricata*, Adams, and *B. pustulosa*, Soland. We cannot therefore speak of this as a nucleus of the teeth. Calvet [†] mentions a conical cavity enclosing a protoplasm "pauvre en granulations, et un noyau dont le situation est variable."

The gizzard of *Cryptopolyzoon*, Dendy, is quite different to any other known gizzard, and as Dendy described it there are "two relatively large chitinous teeth"—"squarish in shape and flattened"—"planted within the muscular mass."

This being so diametrically different from other gizzards, I was anxious to make sections, and the British Museum authorities kindly allowed me to prepare some sections from their preserved material. The zoarium is covered with sand-grains and the walls of the zoœcia are thick chitin, so that even after much labour only moderately successful results were possible. However, the gizzard was found to have very thick and powerful muscles surrounding the two teeth (Pl. **25**. figs. 1, 2, 3), which present two flat surfaces to one another, with slight projections near the border. These gizzards occur near the "cardiac portion of the digestive system," and I distinguish them from other gizzards as being of the grindstone type. It will be noticed in comparing my figures of *Cryptopolyzoon* and *Zoobotryon* &c. that the gizzard and the zoœcia of the first are small (Pl. **25**. figs. 1, 2, 3). The zoœcia are placed close together, sometimes partly attached as in *Amathia*, and from the chitinous wall there are slight projections ending in a disk-like knob which is attached to the grains of sand. The number of zoœcia is very large in each node of *C. Wilsoni*, Dendy [‡]. We must beware of judging without sufficient examination whether there are gizzards in any species, and it is naturally the presence of these teeth, either numerous and pointed as in various species, or the flat grindstones, which proves the existence of the gizzard.

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[*] Bryozoaires Ectoproctes Marins, pl. 7. figs. 4, 8.

[†] Bry. Ectoproctes Marins, p. 230.

[‡] Arthur Dendy, "On the Anatomy of an Arenaceous Polyzoon," Proc. Roy. Soc. Vict. vol. i. (1888) n. s. p. 1, pls. 1, 2, 3; "*Cryptopolyzoon*, an Emendation in Nomenclature," Zool. Anzeiger, vol. xxiii. (1900) No. 620. [*Cryptopolyzoon Wilsoni*, Dendy, also occurs from Knysna, S. Africa (*fide* Kirkpatrick).]

So far as we know, gizzards do not occur in most of the Ctenostomata, but they are known in *Zoobotryon* (*Bowerbankia*), *Amathia*, *Vesicularia*, *Hypophorella* (?), *Buskia socialis*, Hincks (A. W.), *Victorella* (?), *Cryptopolyzoon*. They do not occur in *Farella*, *Mimosella*, *Cylindrœcium*, *Alcyonidium*, *Pherusa*, *Valkeria*.

For some time I have been on the look-out for attached specimens of *Zoobotryon*, and at last found some attached to a seaweed from Boa Vista, Cape Verde Is. The spreading chitinous attachment is large, throwing out digitiform processes (Pl. **24**. fig. 12), and from the round basal cell the tubular stem of the colony grows and soon bifurcates, and there may be a second similar attachment close to it, but in no case have I seen any creeping stolon from which they grow. These spreading attachments are very similar to the anchors at the end of the radicles by which some of the *Cellularidæ* are fastened.

The mesenchym threads which have been the subject of Müller's and Reichert's papers are not the solid cords often represented and figured, but are bundles of fine protoplasmic threads with nuclei, and these threads spreading and anastomosing in all directions are constantly changing. None of the names by which the structure has been designated seem quite satisfactory. "Parenchym Stränge" of Vigelius seemed to express it the best, but this has not been found quite correct; the most frequently used "funiculus" is misleading, as we do not get a solid cord in the Cheilostomata or Ctenostomata like the funiculus as described in the Phylactolæmata, for in this sense no funiculus exists in the Cheilostomata. Many known figures only represent a pathological condition. However, the use of the term has been generally extended to include any of the threads passing to all the organs and to the rosette plates of the zoœcia, avicularia, ovicells, and radicles, and these changing threads take part in all new growth of bud ovaria, testes, avicularia, &c.

As mentioned in a previous paper, the first time I was in Naples I did not see *Zoobotryon*, but the second time I saw buckets full of nothing but *Zoobotryon* brought in.

The distribution of the zoœcia on the stem varies considerably; sometimes the lower part of a joint is bare or it may be covered, as in the specimen from Zanzibar. The younger portions are closely covered with zoœcia and buds.

Loc. Ehrenberg found it at Suez and Alexandria, and Reichert says from almost all seas of the temperate and tropical zones, but we have not further particulars. It occurs in abundance in Naples and Trieste; Miss Philipps found it from the Isle of Pines; South Australia (*MacG.*); from s.s. 'Thyra' from the Mediterranean docked in Suez, collecte after it had been there one month (9); Boa Vista, Cape Verde Island; and Chuaka Bay, Zanzibar (509), 2 fath., all collected by Crossland.

As we have dealt with the species which may be said to be Ehrenberg's type of Bryozoa, it has led me again to think why it is that Ehrenberg's term has not received universal acceptance in England, although nearly general elsewhere; and the conclusion come to is that it is on account of the difficulty of putting ourselves back 100 years, when the thoughts and language of to-day had not become stereotyped.

Nearly thirty years ago * I wrote two short papers giving my reasons for adopting the term Bryozoa, and as I am not fond of polemical discussion I have continued to use it, without again raising the question.

At the time Ehrenberg and Thompson wrote, the discussion as to the animal nature of the zoophytes was comparatively recent, as but little work had been done and the phraseology used previously was largely retained. The animal in the zoophytes was hydra, as we still say Hydrozoa; and Thompson studying the zoophytes was surprised to find that all the animals—that is to say, the polyps—in the zoophytes were not hydra, and he wrote a paper on "Polyzoa, a new Animal inhabiting certain Zoophytes." This idea of the Polyzoa inhabiting the zoophytes occurs every few lines, and he says "the animals of some Cellariæ, Tubuliporæ, and Flustraceæ proved to be Polyzoæ." We cannot consider the paper without remembering that Thompson used Polyzoa as a feminine singular, while it has now been changed into a neuter plural, by which the drift of Thompson's paper has been somewhat obscured.

Hincks says Polyzoa was used in opposition to Hydra. Certainly; but we must not first surround it by our present ideas, with Hydra meaning a class to us, but must look upon Polyzoa as in opposition to Hydra of that time, namely, the polyp of Hydrozoa &c.

I am unable to find anywhere in the paper that Thompson considered that he was giving the name Polyzoa (a singular name) to a class; and if we read the paper in the sense of Polyzoa meaning a polypide, the contribution becomes consistent instead of being most confused.

As a young man when I presented papers, those in authority said, you should not use Bryozoa when Busk and others use Polyzoa. I pointed out my reasons and induced them to examine Thompson's paper, and they all, without exception, said they considered I was quite right and that there could not be any question of Thompson using Polyzoa as a class name. Such able literary and scientific critics as Mr. Dallas and Dr. Francis became quite convinced, and Mr. Dallas † in a review of Hincks's book put the question more clearly than it has been put by anyone else. A number of members of

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* Ann. Mag. Nat. Hist. ser. 5, vol. v. (1880) p. 34.

† 'Popular Science Review,' n. s. No. 14, April 1880.

the staff of the British Museum working upon invertebrates met together to examine Thompson's paper, and unanimously came to the conclusion that Polyzoa was not given as a class designation.

Bryozoa was for a long time used in England, and then Busk introduced Polyzoa as being Thompson's name. I was not surprised that Busk, Allman, and Hincks, who had worked together, did not change, but I felt confident that the change would soon be made by a younger generation. In this I seem to have been mistaken, and so long as any of our leaders use Polyzoa we must recognise that there are two sides to the question, though I find it very difficult to understand how this can be if we try to divest ourselves of the knowledge gained since Thompson's time and put ourselves in his position.

BOWERBANKIA IMBRICATA (*Adams*). (Plate **25**. figs. 6–10.)

Sertularia imbricata, Adams, Trans. Linn. Soc. vol. v. (1800) pl. 2. figs. 5–11.

Miss Jelly's list of synonyms may be consulted and add :—

Bowerbankia imbricata, Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. xix. (1887) p. 309; Levinsen, Zool. Dan. vol. iv. (1894) p. 82, pl. 8. figs. 5–9; Robertson, "Bryozoa," Proc. Washington Acad. of Sciences, vol. ii. (1900) p. 331; Calvet, "Bry. Mar. de Cette," Trav. Inst. de Zool. de l'Univ. de Montpellier, 2nd ser. Mem. 11, p. 90 (1902); Nordgaard, "Hydr. & Biol. Investigations," Bergens Mus. p. 174, pl. 3. fig. 36 (1905); "Bry. from the 2nd Fram Expedition," p. 39 (1906); Loppens, K., "Bry. marins & fluv. de la Belge," Ann Soc. R. Zool. & Malac. de Belge, vol. xli. (1907) p. 308, fig. 22.

At first the specimen from the Sudan was taken to be *B. caudata*, Hincks, on account of the process at the base of the zoœcium, but this is not a character confined to one species, and I find processes on both *B. imbricata*, Adams, and *B. pustulosa*, E. & S., from Poole. These are usually bifurcate or forked and their function has not been generally understood, but they are small rooting processes attaching themselves to seaweed &c., as is seen in some Red Sea specimens. Radicles, as a rule, are separate chambers, only connected to the zoœcial chambers through a diaphragm or rosette plate, whereas here they are only a swelling of the zoœcial wall. Such a growth is not entirely unknown in the Cheilostomata, and I have referred to it in *Schizoporella argentea*, Hincks [*]. These processes are in parts formed on all the zoœcia, although only a few may find an attachment; just as in many Cheilostomata there is a radicle chamber where no radicle is formed. Jullien [†] partially recognised the meaning of these processes when describing his *Bowerbankia minutissima*, and says: "autour de cette base existent des sortes de processus ou de crampons fixant la zoœcie au support colonial." It is at present impossible to recognise any of Jullien's species, and no figures are given.

Levinsen [‡] mentions and figures these processes in both *B. imbricata* and

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[*] Journ. Linn. Soc., Zool. vol. xxxi. (1908) p. 146.

[†] Mission du Cap Horn, p. 21.

[‡] Zool. Danica, "Mosdyr," p. 82, pl. viii. figs. 3, 6.

B. caudata, showing them sometimes branched, and considered them to be the commencement of a new outrunner from the stem.

Loppens * calls *B. caudata* a variety of *B. imbricata* and says: "loges fixées latéralement au stolon, terminées en pointes, on trouve fréquemment les deux formes dans une même colonie." Surely, then, it is not a variety, and I agree with Loppens in thinking that *B. caudata* is not a good species; but Hincks says that it is much smaller than *imbricata,* so that in all probability it is only *B. pustulosa,* in which we know that these zoœcial attachments occur. Ostroumoff † figures processes from the side of his *Vesicularia stationis.* I am not sure what this is, for Ostroumoff regards it as most closely allied to *Valkeria uva,* but he figures a gizzard. Probably *V. stationis* is *Bowerbankia.*

B. imbricata is a much stouter species than *B. pustulosa,* with a much larger gizzard, furnishing a useful character in determination. Many of the determinations of both species require confirmation, for in the earlier descriptions there is inextricable confusion between *B. imbricata, B. pustulosa,* and *Valkeria uva,* for all three species may form thick growths over seaweed as described under the name *densa.* Thompson, in his figure of *Valkeria cuscuta,* shows a gizzard, proving that he had the zoœcium of some other species before him; also Smitt mixed up *Valkeria uva* and *Bowerbankia imbricata,* which accounts for his saying sometimes with and sometimes without a gizzard. The muscles of the gizzard show cross-lines in section (Pl. **25.** fig. 9), and the same is the case in the muscles of *B. pustulosa.*

The *Farella arctica,* Busk, which is in the British Museum, is but a very poor specimen, and is apparently *Bowerbankia,* certainly not *Farella.*

The gizzard of *Bowerbankia imbricata* is the largest of any that have come under my notice, measuring in sections about 0·1 mm. transversely in an ordinary non-inflated condition; *Zoobotryon pellucidum* about 0·08 mm.; *Bowerbankia pustulosa* about 0·07 mm.; *Amathia Brongniartii,* Desm. & Les., 0·07 mm.; *Buskia socialis,* Hincks, about 0·07 mm.; *Amathia lendigera,* Linn., about 0·05–0·06 mm.; *Vesicularia spinosa,* L., about 0·04–0·05 mm.; *Cryptopolyzoon* about 0·02–0·03 mm.

There seems no character yet described by which *Bowerbankia* can be distinguished from *Zoobotryon,* but it is provisionally left until the whole of the Ctenostomata have been fully studied.

Loc. Arctic; Danish, Belgian, French, and British coasts; Mediterranean; Alaska; California, Queen Charlotte Island (*Robertson*); Caspian Sea (fide *Grimm*); Bay of Agig Suraya (south part of Sudan coast, 21), collected by Crossland.

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* "Bry. Marins et Fluviatiles de la Belgique," Ann. Soc. Roy. Zool. & Malac. de Belgique, vol. xli. (1996) p. 286.

† "Études Zool. & Morph. des Bry.," Arch. Slaves de Biol. vol. i. (1886) p. 567, pl. 4 figs. 49–52, pl. 5. fig. 64. (This is a translation of a Russian paper.)

VALKERIA UVA (*Linn.*). (Plate **24.** fig. 13 ; Plate **25.** figs. 4, 12, 13.)

Ellis, J., Nat. Hist. of Corallines, p. 28, Corallina cuscutæ forma &c. pl. 14. fig. C, and Corallina minima repens &c. p. 28, pl. 15. fig. C.

Compare Miss Jelly's Catalogue and add:—

Valkeria uva, Lomas, "Report on Polyzoa," Proc. Lit. Phil. Soc. Liverpool, vol. xl. (1886) p. 189; Levinsen, Zool. Danica, "Mosdyr," p. 83, pl. 8. figs. 10, 11 (1894); Kirkpatrick, Ann. Mag. Nat. Hist. ser. 6, vol. v. (1890) p. 17; Calvet, "Bry. Mar. de Cette," Trav. Inst. de Zool. de l'Univ. de Montpellier, 2nd ser. Mem. 11, p. 93 (1902); Bidenkap, "Fort. over de arkt. Bry.," Bergens Mus. No. 9, p. 44 (1905).

Vesicularia cuscuta, Barrois, "Rech. sur l'Embry. des Bry." p. 199, pl. 11. figs. 1–14 (1877).

Valkeria verticillata, Heller, "Bry. Adr. Meeres," Verh. zool.-bot. Gesellsch. vol. xvii. (1867) p. 129, pl. 6. fig. 4.

Valkeria tuberosa, Heller, *loc. cit.* p. 129, pl. 6. fig. 3.

The creeping form occurs abundantly from Naples, and the number of zoœcia in a group varies considerably; some will have 6–7, whereas I have seen some with as many as 40–50. Those from the Sudan have usually 10–12, but they are attached to *Lepralia japonica* in such a way that they cannot readily be studied.

In specimens with a large number of zoœcia it is seen that a joint is given off from the main stem, and then from this joint two other creeping joints, which again give out a pair, and so on (Pl. **24.** fig. 13). From each short joint grows a zoœcium, thus forming groups of long narrow zoœcia, except where there is a larva, when they are wider and shorter. Possibly those just described with numerous zoœcia should be called var. *tuberosa*, Heller. The distance between these groups is considerable though variable, and in the same way *Bowerbankia pustulosa* and *B. imbricata* have distant groups, though sometimes all three form dense masses. In examining some specimens from Poole out of the so-called salt-water lake (which varies much in saline density), I found that when the groups are forming there is below the septum of the stem a pair of zoœcia (fig. 12), and then immediately below these a pair of growths, which may remain delicate root-like processes, or these may grow to form new stems or occasionally may form zoœcia.

In the slight swelling of the stem from which the zoœcia grow a bundle of muscles is found passing from the upper to the lower surface (see Pl. **25.** figs. 12, 13), and these agree with what Ehlers has figured in *Hyphoporella expansa*, and what we also find in *Farella repens*, Farre. In *Mimosella gracilis*, Hincks, there is in the pinnæ, below each septum, a similar band of muscles (see note p. 239). The creeping stolon is about 0·04–0·05 mm. in diameter, the zoœcia about 0·30 mm. long when closed, so that it is easily distinguished from *Bowerbankia pustulosa* and *imbricata* by being so much smaller. The parietal muscles are grouped and there are two series of muscles, though Farre thought that there was only one "set." Whether the genus *Valkeria* ultimately stands or not, we cannot have *V. uva* and *Farella atlantica*, Busk, in two genera.

Loc. Northern seas; British, Danish, Belgian, and French coasts Mediterranean; China seas; Agig Suraya (in the south part of the Sudan coast), on *Lepralia japonica*, B. (21); Chuaka, Zanzibar (508), collected by Crossland.

CYLINDRŒCIUM DILATATUM (*Hincks*).

See Miss Jelly's list and add:—

Cylindrœcium dilatatum, Calvet, "Bry. Ectoproct." pl. 7. figs. 12, 13; Thornely, "Manaar," p. 128; Record Indian Mus. p. 196; Prouho, Arch. de Zool. Exp. & Gén. 2nd ser. vol. x. (1892) p. 626, pl. 24. figs. 14–17.

The zoœcial wall has very fine latitudinal lines close together, but they cannot always be seen on account of the covering foreign matter. There are about 20 tentacles. The creeping stolon is 0·02 mm. in diameter, whereas in *C. giganteum* it is 0·03–0·04 mm. I have a specimen from Naples believed to be *Cylindrœcium* with a stout chitinous creeping stolon, and the zoœcia are long and wide. Busk's figure of "*Farella gigantea*" shows a large creeping stolon.

Prouho has shown that a swelling takes place at the side of the zoœcial tube near the distal end, and that the ova establish themselves in the cavity thus formed and then escape through a tube which develops from the swelling. None of the specimens of *Cylindrœcium* which have come before me have been in this stage.

Loc. Arctic; British; French; Mediterranean; Manaar, 7–10 fath.; Mangalore, Indian Ocean, 26–31 fath.; Ras el Millan, Sinai Coast, collected by Hartmeyer.

CYLINDRŒCIUM GIGANTEUM (*Busk*).

For synonyms, see Miss Jelly's Catalogue and add:—Calvet, "Bry. d Cette," Tr. Inst. Zool. Montpellier, ser. 2, Mém. 11, p. 91 (1902); Talisman & Travailleur, p. 371 (1907).

Loc. Queen Charlotte Islands; British; Naples; Cette; Adriatic; Corsica; Ceylon; Ras el Millan, collected by Hartmeyer.

ENDOPROCTA.

BARENTSIA GRACILIS (*Sars*).

For synonyms, see Miss Jelly's Catalogue and add:—

Ascopodaria gracilis, Kirkpatrick, Ann. Mag. Nat. Hist. ser. 6, vol. ii. (1888) p. 21; Norman, "Polyzoa of Madeira," Journ. Linn. Soc., Zool. vol. xxx. (1909) p. 277.

Pedicellina gracilis, Levinsen, Zool. Danica, p. 96, pl. 9. fig. 30 (1894).

In my Report on the 'Belgica' Antarctic Bryozoa I showed that *B. discreta* has in some stalks of a colony a node and that on this account the genus

Gondypodaria must fall. These muscular nodes occur in some stalks but not in all of the specimens of *B. gracilis* from the Sudan (3), and the same thing is known in British and Mediterranean specimens. It is referred to by Joliet in his Bry. des Côtes de France, p. 104, and also by Levinsen in his Zool. Danica, p. 96. In one instance the calyx arises from this second muscular node, which also seems to be the case in *B. ramosa*, Robertson.

In specimens from No. 3 Sudan there are delicate spines round the calyx and also on the non-chitinous parts of the stalk, but some calyces may have only one or two spines or none ; and examination of specimens from other localities shows that this is not exceptional, for they occur on my Trieste specimens and on some shown to me by Mr. Waddington from Poole, and on others I collected near Bournemouth, though they may in some cases be overlooked if only examined with very low powers. There is thus no reason for making a new species, even though the spines are stouter than those found elsewhere.

Similarly, there are in my specimens of *B. cernua*, Pall., sometimes spines on the calyx, and Hincks, Joliet, and some others have considered that *Pedicellina cernua*, P., and *P.* var. *glabra*, Sars, are the same species, with the stalk sometimes smooth, sometimes spiny ; nevertheless Ehlers considered them to be distinct species, though from what I have seen there seems no doubt that Hincks was correct and that the presence of spines is not a character of the first importance.

Spines occur both on the stalk and the calyx on Jullien's *P. hirsuta* and on Miss Robertson's *Myosoma spinosa*, which I am not at present prepared to remove from *Barentsia*. Miss Robertson mentions the oblique position of the calyx, but this appearance is sometimes seen in *B. cernua*, and her figure (pl. xvi. fig. 3) suggests that there is here no structural difference of great importance. Sars, in his original description of *B. echinata*, figures and mentions spines on the calyx. In a specimen in my collection from Naples, which otherwise resembles *B. echinata*, there are about 100 stout recurved spines, which also spread out at the base as if they were attached by muscles, and there are also numerous stout spines on the stalk.

Loc. Arctic, British, Danish, French, Mediterranean, Victoria (Australia), Queensland ; Khor Shinab (3) on *Membranipora limosa*, Wat., 10–12 fath., collected by Crossland.

LOXOSOMA KEFERSTEINII, *Claparède*.

A large specimen with many buds from Khor Dongola is no doubt this species, but I was unable to make any detailed examination.

Loc. Naples (*Cl.*), Adriatic (*Hincks*), Khor Dongola, collected by Crossland.

ADDENDA.

AETEA CROSSLANDI, sp. nov. (Plate **24**. fig. 8.).

Pieces of dry seaweeds covered with this species were quite recently sent to me, and, as it is a most interesting species, it seems advisable to add a description to the present communication.

The creeping portion of the zoœcium is narrow pear-shaped, diminishing at the proximal end to a narrow tube; the erect tubular portion is long and narrow, reaching in some cases to 2 mm.; neither part is ringed or spotted, but both are annulated. A new zoœcium arises from the distal end, but sometimes a creeping zoœcium arises from the side. There are also frequently very interesting appendages growing erect from the side: at first they are small tubes; then next they take the form of a coachman's horn; then laterally from the end there is a short tubular prolongation with a very short area, but in other respects corresponding with the ordinary tubular prolongation; then, finally, laterally in the other direction there is a narrow short tube, and in one case this produces an appendage like the one just described. This seems to be a case of small erect zoœcia growing from the older zoœcia. There are one or a pair of these appendages to the creeping zoœcium, though in one case there are several tubes on this creeping part.

This species looks much like the *Aetea ligulata* of Busk; but it is impossible to be sure from the description, and Busk's slide has dried up and nothing can be distinguished.

From Naples I have two mounted specimens of an *Aetea* with a large and creeping portion, and a thick tubular prolongation which is ringed. At the side of the creeping part there are two pairs of appendages (Pl. **24**. fig. 9) having so much the appearance of *Lepas* that I proposed the name *Aetea lepadiformis* for it (Ann. Mag. Nat. Hist. ser. 7, vol. xvii. p. 13). These appendages are probably similar in formation to those now described; but as it is impossible to understand them from dried specimens I have told Mr. Crossland how interesting the specimens are, and that I should like to have the opportunity of cutting preserved material.

In some specimens of *Aetea truncata*, Lands., from Naples, there are in many zoœcia, close to the tube which starts from the dorsal surface, a pair of jointed appendages; sometimes this dorsal tube is continued as a zoœcium, though in one or two cases it produces a minute zoœcium similar to the ordinary ones, but only about a quarter of the size. Both Smitt and Hincks appear to have seen such appendages, but their figures are not very characteristic and do not show that they are usually in pairs and jointed.

Loc. Khor Dongonab, March 3rd, 1909.

A specimen from the coral-nullipore reef Beacon Island, Khor Dongola, marked "violet-colored Polyzoan," is the Hydrocoralline *Distichopora violacea*.

RETEPORA ABYSSINICA, var. EXPANSA, nov.

Retepora abyssinica, Waters, pars, Journ. Linn. Soc., Zool. vol. xxi. p. 176, pl. 18. figs. 8, 9, 10.

In cleaning some pieces of Retepora (from 422) entirely covered with sponge I have come to the conclusion that they should be separated from *R. abyssinica* as a variety. The branches are slightly less stout than those of *abyssinica*, not so much in one plane, branching more frequently and occasionally anastomosing. The avicularium is in the aperture, directed laterally, and usually bifid, whereas in the type the avicularium is removed from the aperture and has a beak seldom bifid. The oral aperture in both is similar, with a labial pore, and there are in the peristome internal ridges giving the appearance of an oral sinus. The ovicells have a similar subtruncate lamina, and the dorsal surface has similar long narrow avicularia sometimes replaced by a pore.

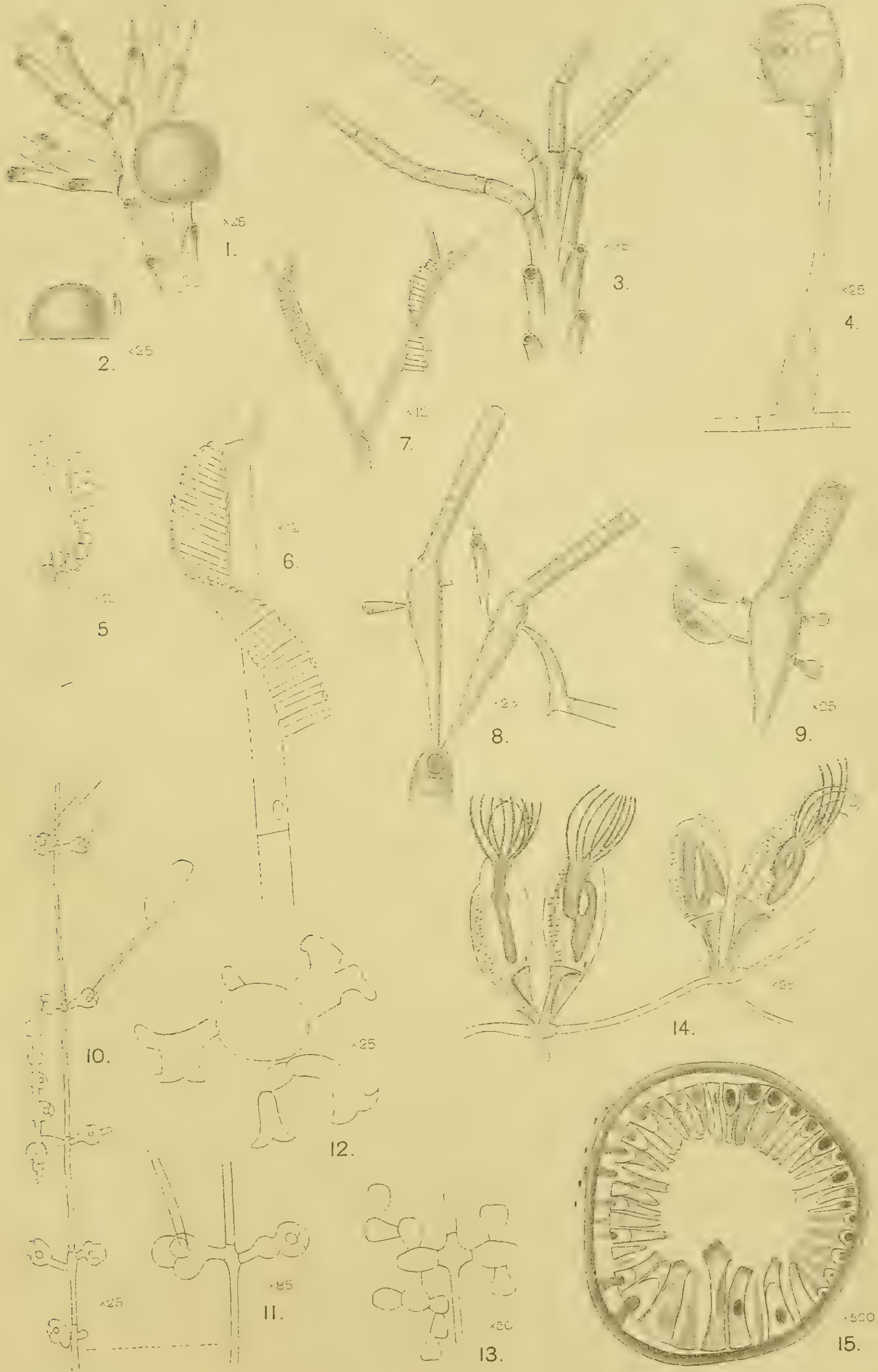
The only important difference is that the frontal avicularium instead of being close up to the aperture has a position nearer the middle of the zoœcium in the type and is larger and directed downwards.

Loc. Lat. 16° N., long. 41° E., 30 fath., collected by Siemens and Löffler. By a most unfortunate slip the type was referred to as from long. 41° W.

In a specimen of *Scrupocellaria Jolloisii*, Aud., from Ras el Millan, there is one raised somewhat lateral gigantic avicularium with a deeply furcate mandible, like that of *Retepora delicatula*, Busk. Although a large number of specimens were examined only this one gigantic avicularium has been found. When the radicles are long they are serrate at the end.

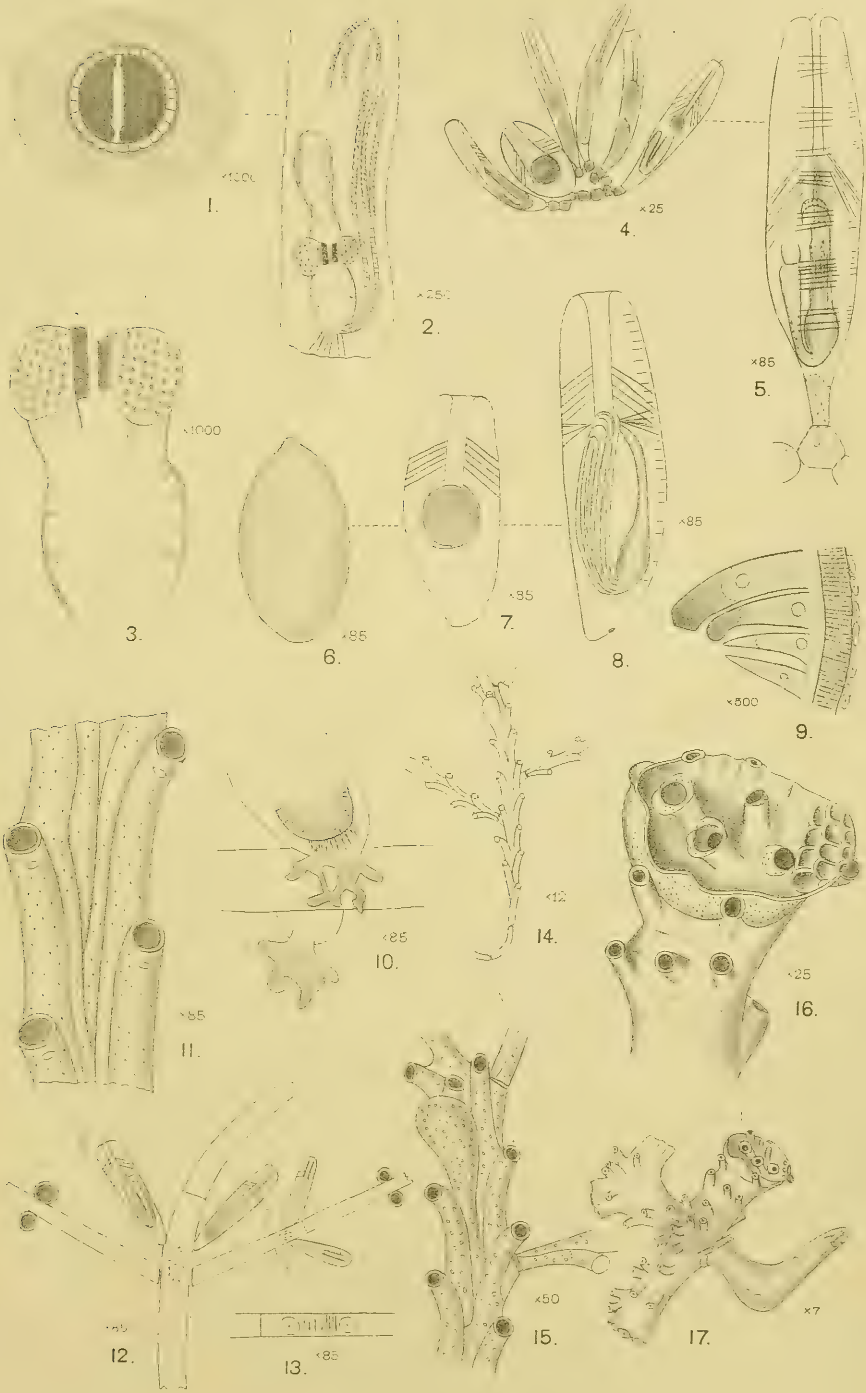
In *Holoporella pigmentaria*, Waters, Gimsah Bay, there are a considerable number of small hydroids (*Clava* or *Coryne*) projecting through the zoarium. The large pore alluded to belonging to the two neighbouring zoœcia (Journ. Linn. Soc., Zool. xxxi. p. 163, pl. 15. fig. 16) is for the passage of the hydroid. I have another *Holoporella* from Zanzibar infested in the same way by a hydroid.

It seems that the locality which is alluded to as Nersa Makdah should be Mersa Makdah, the label having been misread. This volume, pp. 129, 131, 132, 135, 137.



A. W. Waters, del.　　E. Wilson, lith. & imp.

BRYOZOA FROM THE RED SEA.



A. W. Waters, del.

E. Wilson, lith. & imp.

BRYOZOA FROM THE RED SEA.

EXPLANATION OF THE PLATES.

Plate 24.

Fig. 1. *Crisia denticulata*, Lamk. × 25. From Khor Dongola.

2. Do. do. Ovicell, × 25.

3. Do. do. × 25. Showing radicles growing from the distal end of zoarium.

4. *Barentsia gracilis*, Sars. × 25. Showing few spines on the calyx and stalk. From No. 3 Sudan.

5. *Amathia tortuosa*, T.-Woods (non Busk). × 12. From Suez (9).

6. *Amathia semiconvoluta*, Lamx. × 12. From Wasin, Brit. E. Africa.

7. *Amathia distans*, Busk. × 12. From Zanzibar (527).

8. *Aetea Crosslandi*, sp. nov. × 25. Khor Dongola.

9. *Aetea lepadiformis*, Waters. × 25. From Naples.

10. *Triticella Koreni*, Sars. × 25. Basal rhizome showing raised areas at intervals, from which the stalk of the zooecium grows. From Kattegat, Denmark.

11. Do. do. × 85.

12. *Zoobotryon pellucidum*, Ehr. × 25. Basal growth with anchors.

13. *Valkeria uva*, L. × 50. The rhizome seen from below, showing chambers from which the zooecia grow. From Naples.

14. *Farella repens*, Farre. × 25. Showing the creeping rhizome with the swellings from which a pair of zooecia grow. As a rule only one develops, but then there is a short tube opposite the zooecium. There are also two radicles which may remain minute, or develop and carry fresh zooecia. From Poole.

15. *Zoobotryon pellucidum*, Ehr. Gizzard, × 500. Section showing the teeth and the thick muscular sheath surrounding it. It will be seen that where the muscular sheath has become separated the contents of the teeth are attached to it, and more or less drawn out of the teeth.

Plate 25.

Fig. 1. *Cryptopolyzoon Wilsoni*, Dendy. Transverse section of gizzard, × about 1000. This shows the two solid "teeth" surrounded by the very powerful muscles, and at each end of the tooth there are small protuberances. It will be noticed that this is much smaller than the gizzards of other species. From Port Phillip Heads, Australia. Drawn as seen under $\frac{1}{12}$ immersion.

2. Do. do. Longitudinal section through the zooecium, × 250.

3. Do. do. Longitudinal section showing the two teeth and the sections of the muscular wall, × about 1000.

4 *Valkeria uva*, L. × 25. Showing group of zooecia growing on joints. From the Sudan (21).

5 Do. do. × 85. Zooecium showing the parietal muscles.

6. *Bowerbankia imbricata*, Hincks. × 85. Showing empty zooecial chamber.

7. Do. do. Showing zooecium with larva.

8. Do. do. Showing ordinary zooecium.

9. Do. do. × 500. Small portion of gizzard with the surrounding muscles.

10. Do. do. × 85. Showing the radicle processes at the base of a pair of zooecia. From Poole.

11. *Crisia denticulata*, Lam. × 85. Showing the light thin mark below the aperture. From the Sudan (19).

Fig. 12. *Valkeria uva*, Linn. × 85. Portion from near the growing end, showing a pair of zooecia and immediately below a pair of processes which may form radicles or grow into fresh branching stems, or even sometimes into fresh zooecia. The attachments of muscles, in the stem, below the septum are also shown. From Poole.

13. *Valkeria uva*, Linn. × 85. Stem seen from the sides, showing the zooecial and stem rosette plate, and the muscles below the septum.

14. *Crisia cylindrica*, Busk. × 12. From Gimsah Bay.

15. Do. do. × 50. From Gimsah Bay.

16. *Filisparsa tubulosa*, Busk. × 25. Showing the ovicell in course of formation. The finely perforated wall is commencing to grow from the frontal wall and from the wall of each zooecium. From Ras el Millan.

17. Do. do. × 7.

REPORTS on the MARINE BIOLOGY of the SUDANESE RED SEA.—XVI. PYCNOGONIDA from the RED SEA and INDIAN OCEAN, collected by Mr. CYRIL CROSSLAND. By GEORGE H. CARPENTER, B.Sc. Lond., M.R.I.A., Professor of Zoology in the Royal College of Science, Dublin. (Communicated by Prof. W. A. HERDMAN, F.R.S., F.L.S.)

(PLATES **26** & **27**.)

[Read 16th December, 1909.]

THROUGH the courtesy of Prof. Herdman of Liverpool and Dr. W. T. Calman of the British Museum, I have been entrusted with a few examples of "sea-spiders" collected on the east coast of Africa by Mr. Cyril Crossland. They prove to belong to undescribed species of the widespread genera *Nymphon* and *Pallenopsis*.

The localities from which these specimens were obtained lie to the north and east of the district surveyed by Prof. Stanley Gardiner, whose collection of Pycnogonida I have recently (1907) described. The present short contribution may be regarded as supplementing, to some extent, the account of Prof. Gardiner's collection, and I use here the same terminology as in that paper (*l. c.* pp. 95–6).

Family **Nymphonidæ**.

NYMPHON, *Fabr.*

NYMPHON MACULATUM, sp. nov. (Plate **26**. figs. 1–9.)

Male, length 6 mm. (including proboscis).

Head half the total length of the body, neck slender and elongate. Pro-